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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a r quest for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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TITLE OF THE INVENTION (280 characters max)

CONTOUR DEVELOPMENT PROCESS

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* 14

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☐ Application Data Sheet. See 37 CFR 1.76

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METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

☐ A check or money order is enclosed to cover the filing fees

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: ____________

Respectfully submitted,

SIGNATURE [signature]

Date 12/23/2003

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Attorney Docket No. 19365-093431

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CONTOUR DEVELOPMENT PROCESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method of designing seating assemblies, and more particularly, to a process for designing the contours for the seat back of a seating assembly for maximum occupant support and comfort.

2. Description of the Prior Art

Seat design has become increasingly important with respect to the design of automobiles as engineers attempt to design seating assemblies that are both safe and comfortable, however, consumers are commonly dissatisfied with automobile seat comfort, or lack thereof. Upon close analysis, the most highly ranked dissatisfaction was with poor or uncomfortable lumbar support. This may refer to either the lumbar mechanism or the lower back seating contour.

The greatest challenge engineers face when designing seats has to do with the multitudes of different body sizes and shapes. When designing seats, a supplier typically samples the complete population with respect to both morphology (shape) and anthropometry (structure), in order to have representative models for use in seat design. It is important when designing seat backs to also consider the specific structure of the spinal column, since the inherent structure of the spinal column is consistent over the entire population.

The spinal column has a specific number of vertebrae – a taller person does not have more vertebrae, but instead has bigger vertebrae. The placement of a person's vertebrae dictates that person's lumbar curve, or lordosis. The length of this curve depends on the torso length of the particular individual, meaning the apex of this curve can vary up to about 120mm. This means that designing a seat back to accommodate such a varying population becomes

challenging at best. There is a need in the art for a method of better designing the curvature of a seat back to accommodate and be comfortable for a significant portion of the population.

The present invention uses an inside-out design methodology, which considers an occupant to the seat rather than the seat to the occupant, and anatomical landmarks of the occupant to support the lower back. This is an alternate approach to the more common lumbar support concept. This alternate approach allows a designer to design a seat back based on cross-sectional human dimensions (transverse plane), rather than longitudinal dimensions (saggital plane). This design also offers a larger surface contact area (the pelvis) rather than the traditional lumbar (lumbar spine area). In addition, the present invention assists in controlling dynamic effects (micro motions) transferred to the spinal muscles (erector spinae) that are associated with road vibration transmissions. These vibration transmissions elicit a rapid firing of the spinal muscles ultimately leading to muscle fatigue condition and thus, discomfort.

SUMMARY OF THE INVENTION

According to one aspect of the invention, a method for designing the contours for a seat back of a seat assembly for maximum occupant support and comfort is provided. The process involves the use of CAD software and a simulated design manikin. The process begins with identifying the hip point and the torso line of the manikin. A centerline contour of the seat back is then constructed to serve as the basis of how the seat will support occupants in the relatively vertical sense. Next, the shape of the lumbar section of the seat back is determined using a lumbar shape reference circle. An overall centerline contour is then constructed to determine the overall seat back shape. Next, a horizontal seatback contour is constructed in order to serve as the basis of how the seat will horizontally support its occupants' torso. Finally, a bolster contour is constructed to determine the shape and angle of the bolsters at the edges of the seat back for

holding the occupant in the seat during cornering and providing stabilizing support of the occupant during straight driving.

BRIEF DESCRIPTION OF THE DRAWINGS

Advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 is a plan view of a design manikin with the hip point and torso line determined as explained in the process below.

Figure 2 is a plan view of the torso of a design manikin with various construction shapes used to determine the contours of a seat back as described in the process.

Figure 3 is a plan view of the construction of a horizontal seat back contour.

Figure 4 is a plan view of the construction of the middle seat back bolster contour.

Figure 5 is a plan view of the construction of the upper seat back bolster contour.

Figure 6 is a plan view of the overall seat back contours as constructed in the process as described herein.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Figure 1, the process of developing seat contours generally begins with identifying the hip point 10 ("Hpt") of the design manikin 14 and the associated torso, or upper body, line 12. These are determined in space based on the design position of the design manikin associated with the particular vehicle environment in which the seat is to be located. Once these reference features have been identified, the designer can then begin the construction of the seat back contour that will optimally support the full range of intended occupants. This is accomplished by following the identified design process herein.

The first main step of this design process is to determine the centerline contour of the seat back. This is the relatively vertical shape (usually rotated rearward relative to vertical based on the intended design recline angle of the seat, which varies according to the goal of the design, and is generally parallel to the design manikin torso line) of the seat back with a location that is along the center of the seat back in the horizontal sense. This reference shape is the basis of how the seat will support its occupants in the relative vertical sense.

1. Determining the Lumbar Support Shape with a Lumbar Centerline Contour

Referring to Figure 2, the Hpt 10 and torso line 12 of the design manikin 14 must first be located and identified. The next step is to create the proper lumbar support shape based on the proper lumbar apex location and surface radius in this region. This is accomplished by constructing a lumbar apex reference point 16 vertically upward from the design manikin Hpt 10 along the design manikin torso line 12 a specified distance based on anthropometric landmarks. Using the lumbar apex reference point 16 as the origin, a rearward lumbar apex reference line 18 is extended rearward and perpendicular to the design manikin torso line 12 in such a manner that the end of the line 18 is substantially distant from the origin. This rearward lumbar apex reference line 18 is then used as a reference to establish the desired amount of lumbar support prominence. In order to achieve this, two lines perpendicularly related to the rearward lumbar apex reference line must be created.

The first perpendicularly related line, the rearward lumbar prominence line 20, extends between a rearward origin 22 and a rearward endpoint 24. The rearward origin 22 is located along the rearward lumbar apex reference line 18 at a specified distance forward of the intersection of the rearward surface of the design manikin torso 14 and the rearward lumbar apex

reference line 18. The rearward lumbar prominence line 20 extends from the rearward origin 22 in a relatively vertical sense parallel with the design manikin torso line 12 to the rearward endpoint 24, which is distant from the rearward origin 22.

The second perpendicularly related line, the forward lumbar prominence line 30, extends between a forward origin 32 and a forward endpoint 34. The forward origin 32 is located along the rearward lumbar apex reference line 18 at a specified distance forward of the intersection of the rearward surface of the design manikin torso 14 and the rearward lumbar apex reference line 18. The specified distance is representative of the total lumbar deflection desired. The forward lumbar prominence line 30 extends from the forward origin 32 in a relatively vertical sense, parallel with the design manikin torso line 12 to the forward endpoint 34 which is distant from the forward origin 32.

A lumber shape reference circle 40 is then created having its origin 42 located along the rearward lumbar apex reference line 18 and its forward most surface tangent to the rearward lumbar prominence reference line 20. The radius of the circle 40 is representative of the desired shape of the lumbar support region and is determined based on anthropometric dimensions of the human body.

2. Determining the Overall Seat Back Shape with an Overall Centerline Contour

Using the rearward lumbar prominence reference line 20, an upper seat back contour transition reference point 50 is created along the rearward lumbar prominence reference line 20 a distance above the rearward origin 22 based on anthropometric landmarks of the human body. A lower seat back contour transition reference point 52 is created at the tangency location of the lumbar shape reference circle 40 and the forward lumbar prominence reference line 30. A

transition shape 54 extending between the lower seat back contour transition reference point 52 and the upper seat back contour transition reference point 50 is created by means of a shaping function, a feature commonly provided by CAD software packages. A lower seat back contour endpoint 60 is identified by the intersection of the lumbar shape reference circle 40 and the seat cushion contour 62.

The overall seat back contour 64, which is used to determine the overall seat back shape, is identified as the shape extending from the lower seat back contour endpoint 60 generally vertically extending along the lumbar shape reference circle 40 to the lower seat back contour transition reference point 52, from the lower seat back transition reference point 52 along the transition shape 54, accomplished by means of a mathematical shaping function, to the upper seat back contour transition reference point 50, from the upper seat back contour transition reference point 50 along the rearward lumbar prominence line 20 to an upper seat back contour end point 66, determined by the required design height of the seat back, which can vary depending on the seat being designed.

3. Determining the Horizontal (Cross-Car) Seat Back Contours

The second main step of this design process is the cross-car (horizontal) contour of the seat back. This is the relatively horizontal shape of the seat back and is perpendicularly related to the centerline contour at specific locations along the seat back. The specific locations of the specified cross-car contours are determined based on specific anthropometric landmarks of the human body. These have been translated to specific locations of the design manikin to ensure a consistent design methodology. This design feature provides proper support to the occupant's

back while not exerting excessive load onto the spinal processes (vertebral bodies of the spine). Minimizing load to these bodies improves both physical and perceived occupant comfort.

Referring to Figure 3, two identical copies of the overall seat back contour 64 are made. These two copies, the outer overall seat back centerline contours 70 (the first contour 70a and the second contour 70b, respectively) are constructed horizontally located outward and parallel to the original overall seat back contour 64. The distance between each of the outer overall seat back centerline contours 70 and the overall seat back centerline contour 64 is determined by the anthropometry of the human body. Each outer overall seat back centerline contour 70 shall be adjusted perpendicularly forward of the design manikin torso line 12, such that each contour 70 is forward of the original overall seat back centerline contour 64. Two additional identical copies of the original overall seat back centerline contour 64 are constructed. These two copies, the inner overall seat back centerline contours 72, are horizontally located outward and parallel to the original overall seat back centerline contour 64. The distance between the overall seat back centerline contour 64 and each of the inner overall seat back centerline contours 72 is determined by the anthropometry of the human body. Each inner overall seat back centerline contour 72 shall be forwardly adjusted along a line perpendicular to the design manikin torso line 12, such that it is forward of the original overall seat back centerline contour 64 and rearward of the outer overall seat back centerline contours 70.

To construct a middle horizontal seat back contour 74 that spans horizontally across the middle of the seat back in a vertical sense, construct a middle horizontal seat back contour construction point 76 located at the intersection of a plane perpendicular to the design manikin torso line 12 and containing the lumbar apex reference point 16. Then, construct a middle horizontal seat back contour construction circle 78, having a radius defined based on the

anthropometry of the human body. The circle 78 resides in a plane that is perpendicular to the overall seat back centerline contour 64, tangent to each outer overall seat back centerline contour 70, tangent to each inner overall seat back centerline contour 72, and contains the middle horizontal seat back contour construction point 76. The middle horizontal seat back contour 74 is the line having a beginning point at the tangency point 80 of the middle horizontal seat back contour construction circle 78 and the first outer overall seat back centerline contour 70a, containing each tangency point 82, 84, 86 of the middle horizontal seat back contour construction circle 78 and each of the inner overall seat back centerline contours 72 and the overall seat back centerline contour 64, respectively, and having an end point 88 defined by the tangency of the middle horizontal seat back contour construction circle 78 and the second outer overall seat back centerline contour 70b.

To construct the lower horizontal seat back contour 74', construct a lower horizontal seat back contour construction point 76' located at the intersection of a plane perpendicular to the design manikin torso line 12 and containing the design manikin Hpt 10. Construct a lower horizontal seat back contour construction circle 78', having a radius one and half times the size as the middle horizontal seat back contour construction circle 78, and residing in a plane perpendicular to the overall seat back centerline contour 64, tangent to each outer overall seat back centerline contour 70, tangent to each inner overall seat back centerline contour 72, and containing the lower horizontal seat back contour construction point 76'. The lower horizontal seat back contour 74' is the line having a beginning point at the tangency point 80' of the lower horizontal seat back contour construction circle 78' and the first outer overall seat back centerline contour 70a, containing each tangency point 82', 84', 86' of the lower horizontal seat back contour construction circle 78' and each inner overall seat back centerline contours 72 and

the overall seat back centerline contour 64, and having an end point 88' defined by the tangency of the lower horizontal seat back contour construction circle 78' and the second outer overall seat back centerline contour 70b.

To construct the upper horizontal seat back contour 74'', construct a upper horizontal seat back contour reference point 90 located vertically above the lumbar apex reference point 16 at a desired distance based on the anthropometry of the human body. Construct an upper horizontal seat back contour construction point 76'' located at the intersection of a plane perpendicular to the design manikin torso line 12 and containing the upper horizontal seat back contour reference point 90. Construct an upper horizontal seat back contour construction circle 78'', having a radius twice the size of the middle horizontal seat back contour construction circle 78, residing in a plane perpendicular to the overall seat back centerline contour 64, tangent to each outer overall seat back centerline contours 70 (adjusted 10mm outward from the location when constructing the lower and middle horizontal seat back contours), tangent to each inner overall seat back centerline contour 72 (adjusted 10mm outward from the location when constructing the lower and middle horizontal seat back contours), and containing the upper horizontal seat back contour construction point 76''. The upper horizontal seat back contour 74'' is defined by the line having a beginning point at the tangency point 80'' of the upper horizontal seat back contour construction circle 78'' and the first outer overall seat back centerline contour 70a, containing each tangency point 82'', 84'', 86'', respectively, of the upper horizontal seat back contour construction circle 106 and each inner overall seat back centerline contours 72 and the overall seat back centerline contour 64, and having an end point 88'' defined by the tangency of the upper horizontal seat back contour construction circle 106 and the second outer overall seat back centerline contour 70b.

The overall horizontal seat back contour 92 is defined by the shape resulting from the surface connecting the lower horizontal seat back contour 74' to the middle horizontal seat back contour 74 by means of a mathematical shaping formula, and the shape resulting from the surface connecting the middle horizontal seat back contour 74 to the upper horizontal seat back contour 74" also by means of a mathematical shaping function. A mathematical shaping function is necessary to connect the contours, as the shape will not be consistent.

4. Determining the Seat Back Bolster Contours

The final main step of this design process is the bolster contours of the seat back. This is the relatively extended portion of the seat back along its outer border in the horizontal sense. The function of this shape is both to hold the occupant in the seat during cornering as well as to provide stabilizing support of the occupant during standard driving (straight driving). These shapes are angularly related to the centerline contours at specific horizontal (width) locations. The proper placement in the horizontal direction as well as the proper angular relationship allows the seat to accommodate the full range of intended users.

Referring to Figure 4, using the perimeter defined by the outward boundaries of the horizontal seat back contours developed above, the required seat back bolster contours can be designed. The middle seat back bolster contour construction line 100 is defined as a straight line connecting the end points 80, 88 of the middle horizontal seat back contour 74. The middle seat back bolster contour reference lines 102 are defined by lines having their origin at each middle horizontal seat back contour end point 80, 88 and extending substantially forward and rotated outwardly 30 degrees from a respective pair of planes perpendicular to the middle seat back bolster contour construction line 100 and containing the middle horizontal seat back contour 74.

The inner seat back bolster reference point 104 for each middle seat back bolster contour 98 is defined by the intersection of the middle seat back bolster reference line 102 and a line perpendicularly forward 60mm and parallel to the middle seat back bolster construction line 100. The outer seat back bolster reference point 106 for each middle seat back bolster contour 98 is defined by the intersection of the middle seat back bolster reference line 102 and a line 108 perpendicularly forward 115mm and parallel to the middle seat back bolster construction line 100. The middle seat back bolster contours 98, respectively inboard 98a and outboard 98b, are defined by the length of each middle seat back bolster contour reference line 102 with end points defined as the inner seat back bolster contour reference point 104 and the outer seat back bolster reference point 106.

Referring to Figure 5, the upper seat back bolster contour construction line 100' is defined as a straight line connecting the end points 80'', 88''of the upper horizontal seat back contour 74''. The upper seat back bolster contour reference lines 102' are defined by lines having their origin at each upper horizontal seat back contour end point 80'', 88'' and extending substantially forward and rotated outwardly 30 degrees from a respective pair of planes perpendicular to the upper seat back bolster contour construction line 100' and containing each of the upper horizontal seat back contours 74''. The upper seat back bolster contour 98', respectively inboard 98a' and outboard 98b', are defined by the length of the upper seat back bolster contour reference line 102', between a beginning point defined by the intersection of the upper seat back bolster contour construction line 100' and the upper horizontal seat back contour 74'' and an ending point defined by the intersection of the upper seat back bolster contour reference line 102' and a line perpendicularly forward 60mm and parallel to the upper seat back bolster contour construction line 100'.

The overall seat back bolster contours 110, a pair of surfaces inboard 110a and outboard 110b respectively, are defined to be the surface created by connecting the upper seat back bolster contour 98' and the middle seat back bolster contour 98 by means of a mathematical shaping formula. Each seat back bolster surface 110, inboard 110a and outboard 110b, are located relatively in space such that they do not necessarily make contact with the overall horizontal seat back contour 92.

The invention has been described in an illustrative manner, and it is to be understood that the terminology that has been used, is intended to be in the nature of words of description rather than of limitation. Accordingly, any measurements used were for one particular application of the process and one skilled in the art will recognize that such measurements may be varied depending on the goals of the particular application.

Many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed is:

1. A method of designing the contours for a seat back of a seat assembly for maximum occupant support and comfort using CAD software and a simulated design manikin, said method comprising the steps of:

identifying a hip point of the design manikin;

identifying a torso line of the design manikin;

determining a centerline contour of the seat back which serves as the basis of how the seat will support its occupants in the relatively vertical sense;

constructing a lumbar shape reference circle to determine the shape of the lower portion of the seat back;

constructing an overall centerline contour to determine the overall seat back shape;

constructing a horizontal seat back contour to serve as the basis of how the seat will support its occupants' torsos in the relatively horizontal sense; and

constructing a bolster contour to determine the shape and angle of the bolsters at the edges of the seat back for holding the occupant in the seat during cornering and providing stabilizing support of the occupant during straight driving.

ABSTRACT

A method of designing the contours for a seat back of a seat assembly for maximum occupant support and comfort utilizing CAD software and a simulated design manikin. A centerline contour is constructed, serving as the basis of how the seat will support its occupants in the relatively vertical sense. The shape of the lumbar support is determined by constructing a lumbar shape reference circle. Next, an overall centerline contour is constructed to determine the overall seat back shape in the vertical sense. Then, a horizontal seat back contour is constructed to serve as the shape of the seat back in a horizontal sense. Finally, a bolster contour is constructed to determine the shape and angle of the bolsters at the edges of the seat back for holding the occupant in the seat during cornering and providing stabilizing support of the occupant during straight driving.

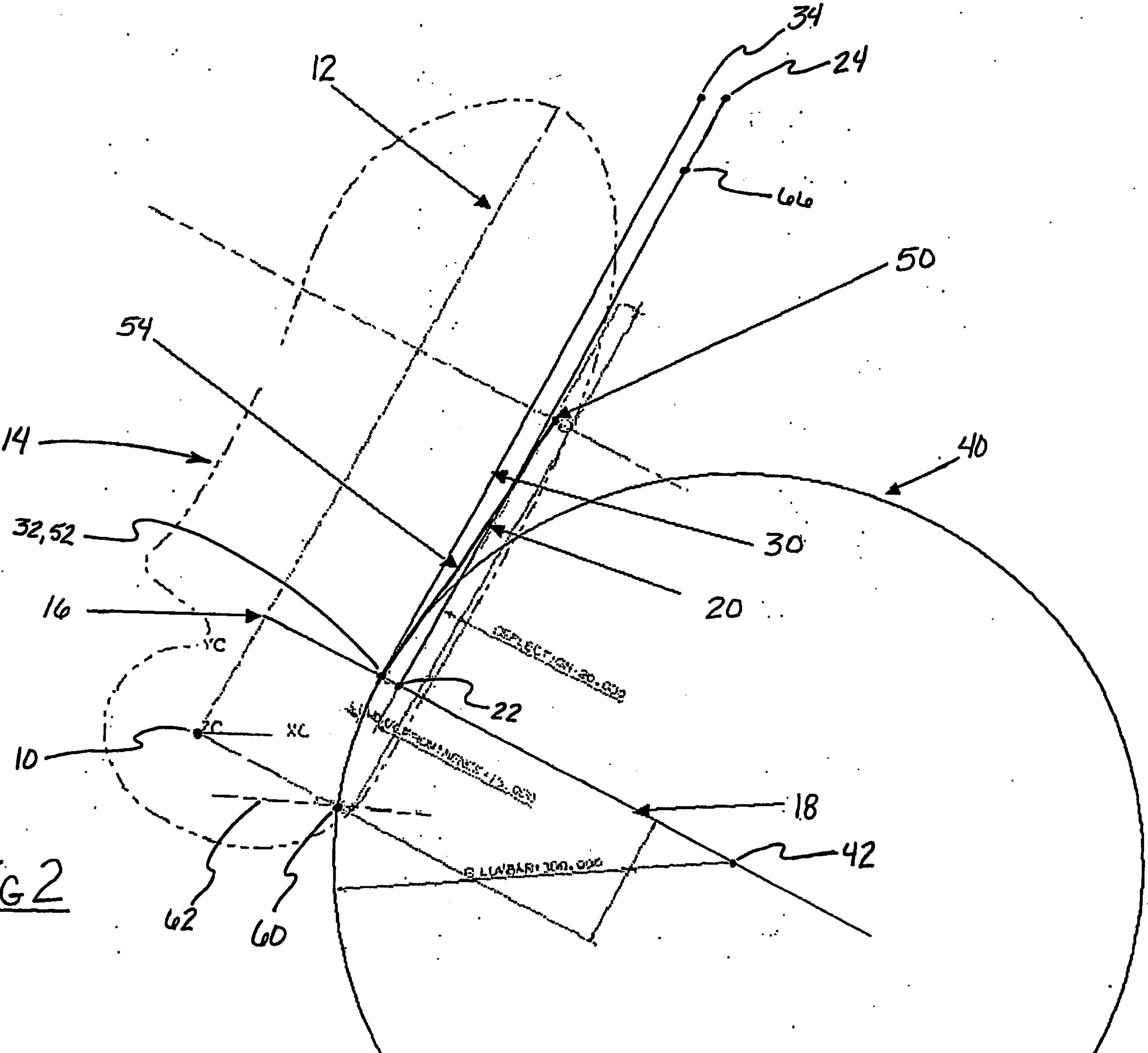

FIG 2

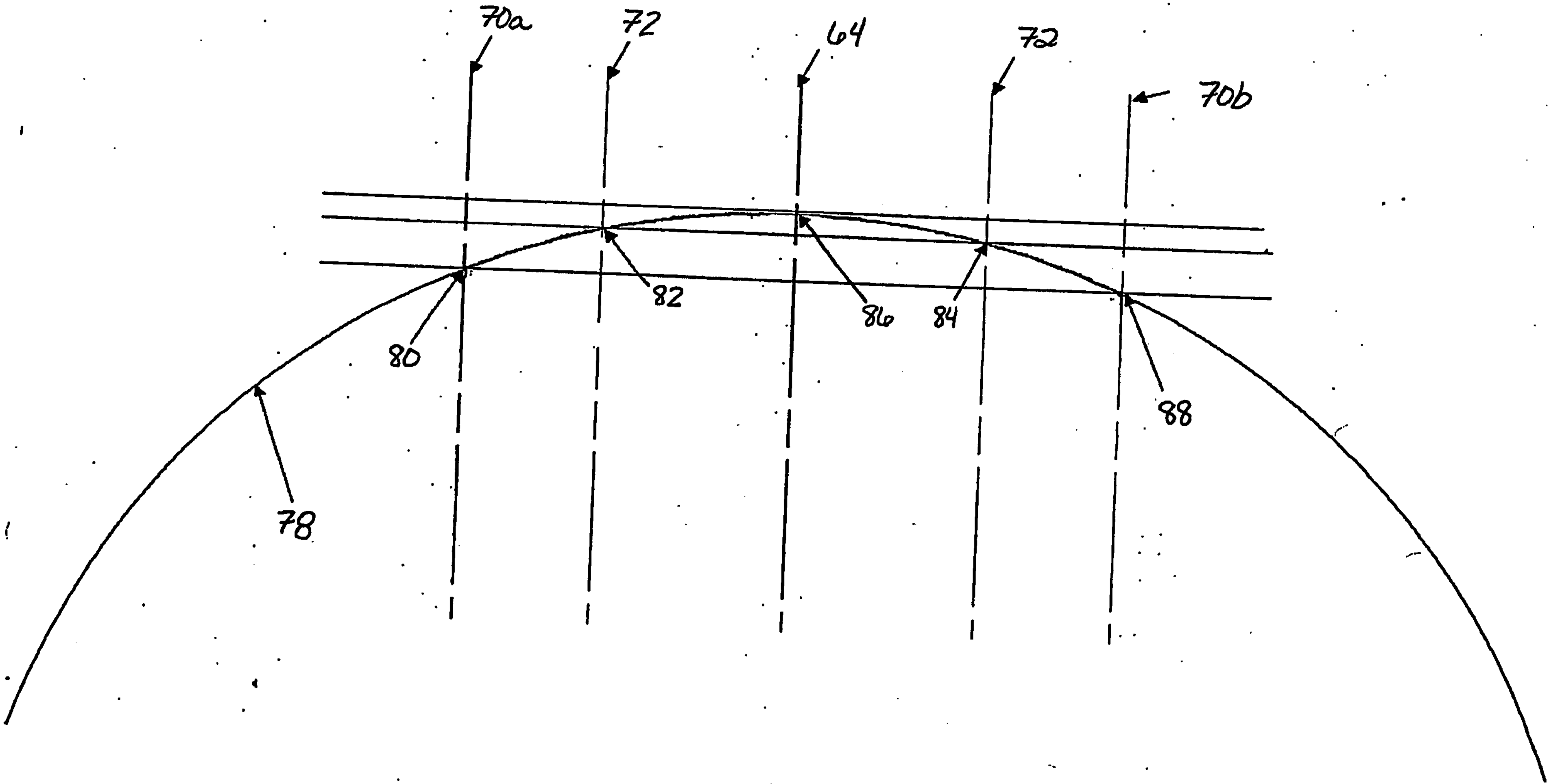

FIG 3

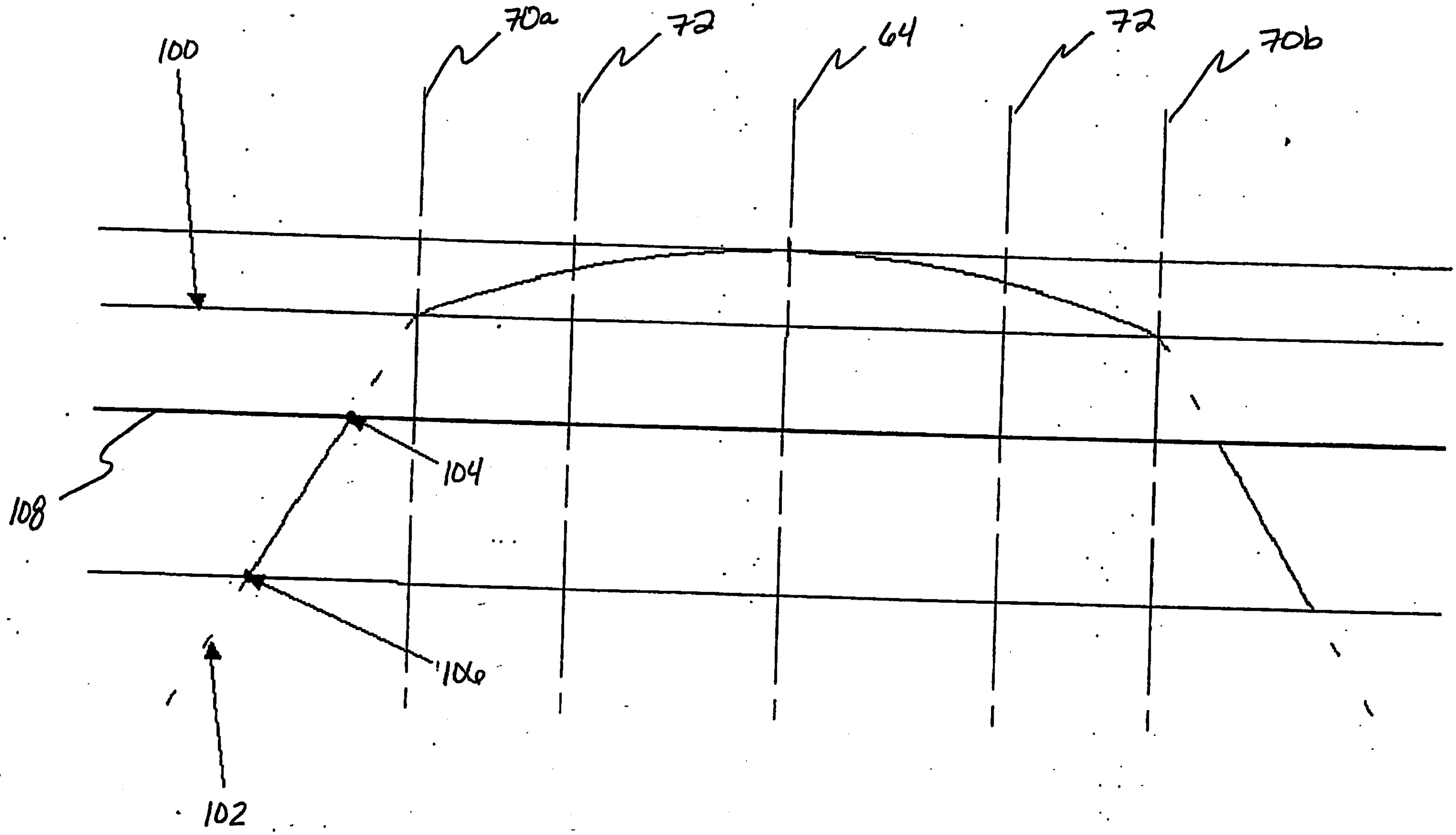

FIG 4

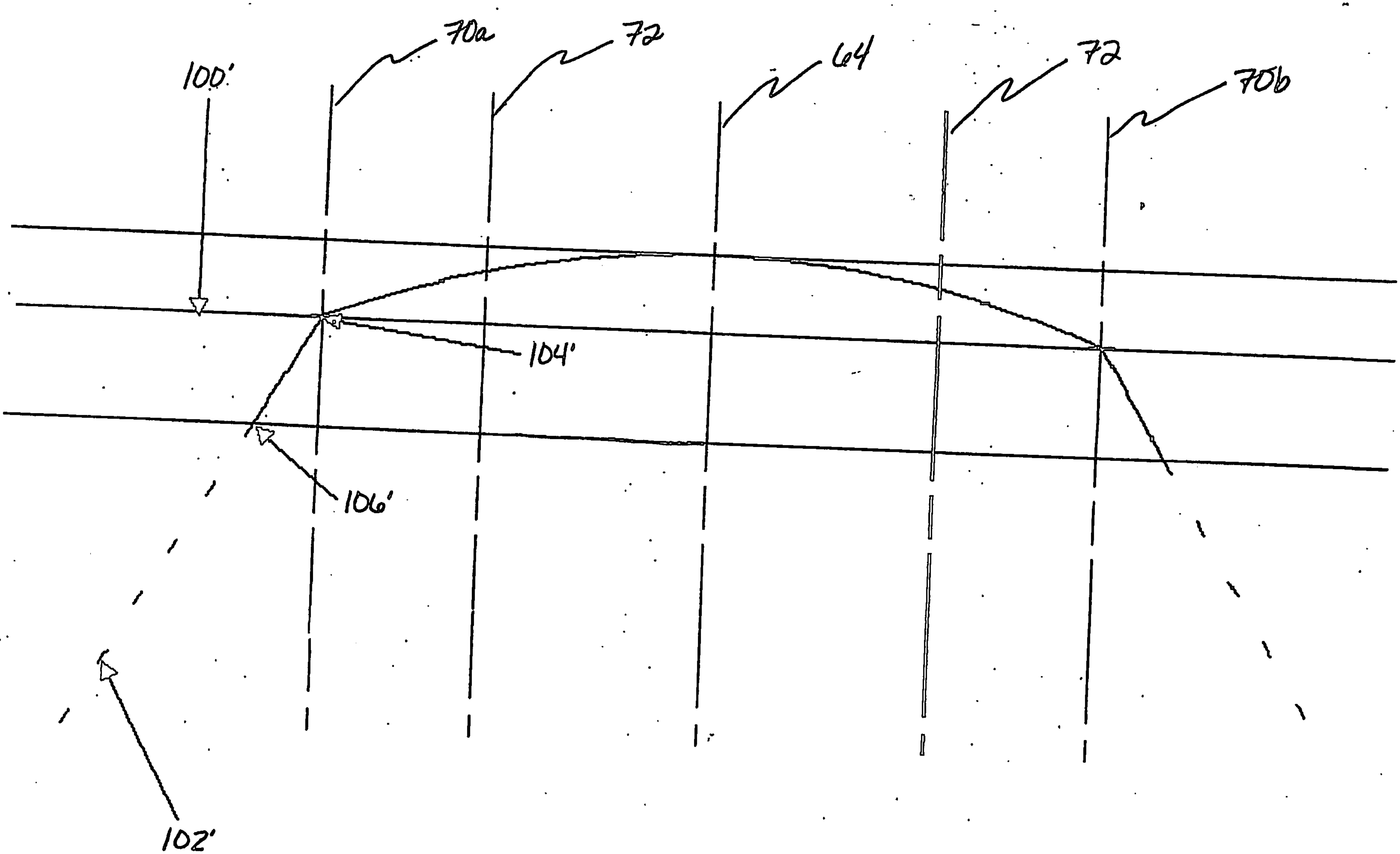

FIG 5

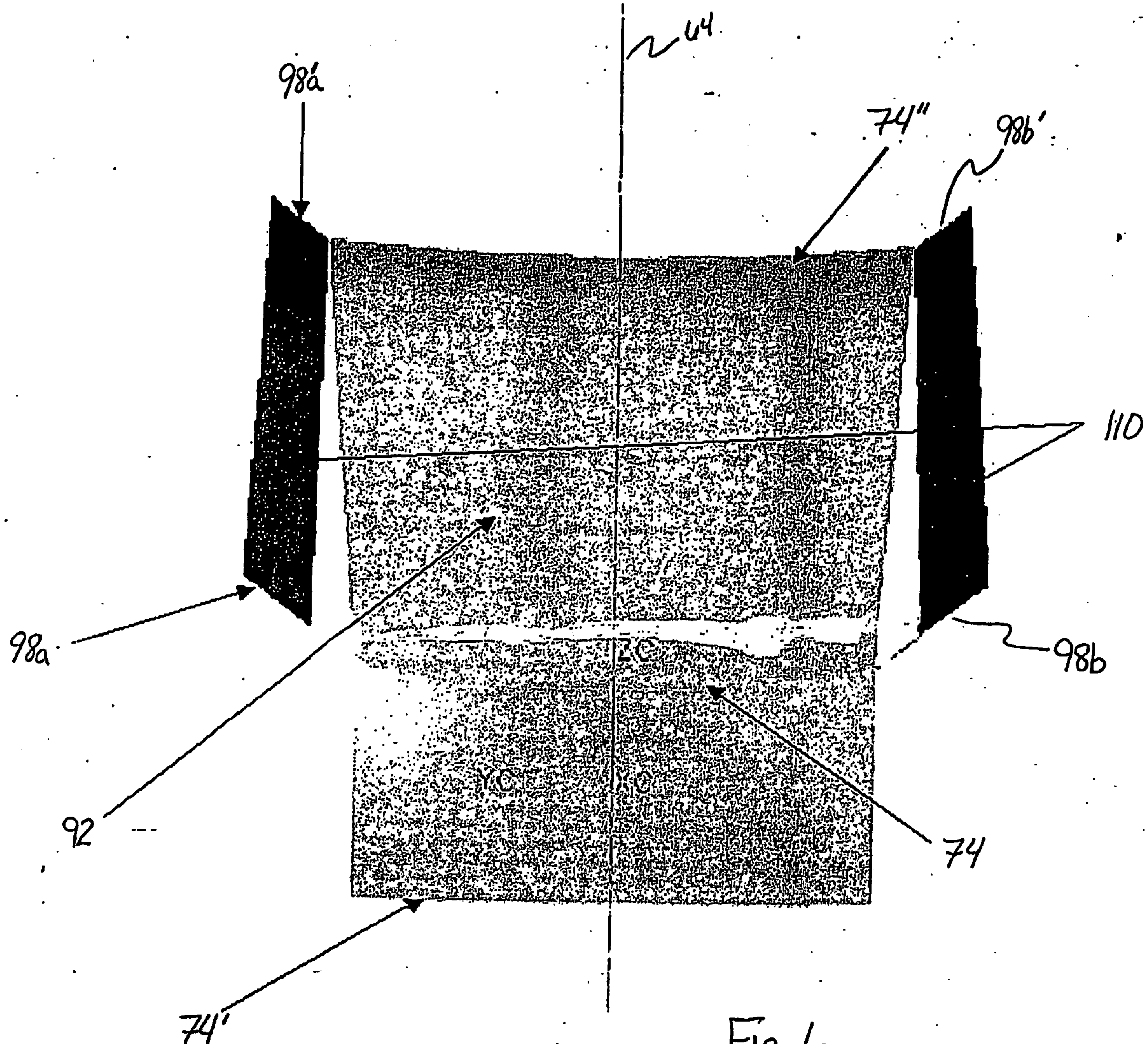

FIG 6